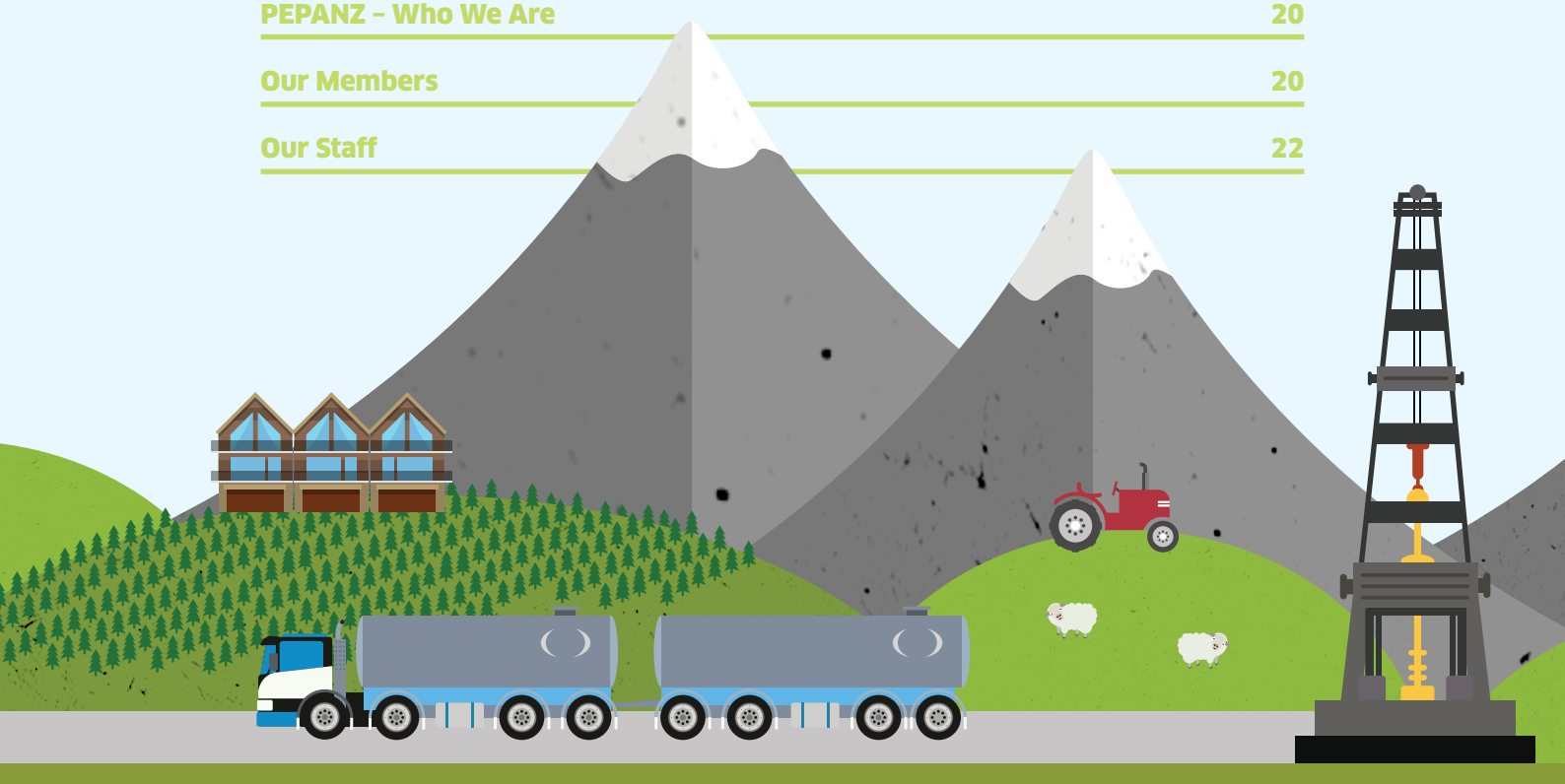
PEPANZ
PETROLEUM EXPLORATION & PRODUCTION ASSOCIATION OF NEW ZEALAND

POWERING TO 2050

A VISION FOR NATURAL GAS IN NEW ZEALAND

CONTENTS



EXECUTIVE SUMMARY

Natural gas has a major long-term role to play in providing affordable, reliable and sustainable energy for New Zealand.

- It can help achieve net zero emissions by replacing coal, encouraging electrification, and producing hydrogen in the most economic way. Emissions can also be captured and prevented from entering the atmosphere.
- Trying to achieve a net zero emissions target by completely replacing the role of natural gas could cost as much as $7.2 billion per year by 2050.[1]
- Natural gas helps keep the lights on by providing a crucial back-up of stored energy, available instantly to meet peak demand when renewable electricity sources are not sufficient.
- This back-up role keeps electricity prices under control and lower than they would otherwise be.
- Natural gas is also used in a wide range of ways that don't involve burning it and releasing emissions, such as in producing plastics, methanol, fertiliser and a range of chemical products.
- By 2050 New Zealand could be clean, green and prosperous thanks to careful development of our natural gas resources.
- To achieve this we will need long-term bi-partisan policies that allow for offshore exploration, appraisal, development and production of natural gas.
- Governments should encourage and enable the offsetting and capture of emissions.
- Policy settings should encourage lower emissions but be neutral towards different fuels and technologies to allow the best solutions to be found.
- Governments should also consider a sovereign wealth fund (similar to Norway) to invest the proceeds from development for future generations.

See pages 18 – 19 for references

INTRODUCTION

Access to energy is a fundamental human need. It is essential to every part of our daily life, helping provide food, shelter, transport, cooking and heating. It also powers industry, providing jobs and a modern standard of living.

In New Zealand natural gas is a crucial part of our energy system providing 21% our primary energy.[2]

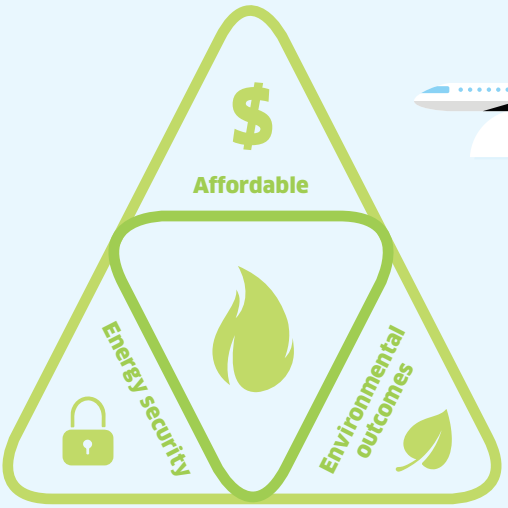
However, the world is changing. Major efforts are underway to reduce net greenhouse gas emissions which means big changes for nearly every industry, especially the energy sector.

As part of this, the New Zealand Government has signalled targets of having net zero emissions by 2050.[3] Along with the end to new exploration permits beyond onshore Taranaki, this has raised important questions about the future for natural gas.

> **“IN NEW ZEALAND NATURAL GAS IS A CRUCIAL PART OF OUR ENERGY SYSTEM PROVIDING 21% OUR PRIMARY ENERGY.[2]”**

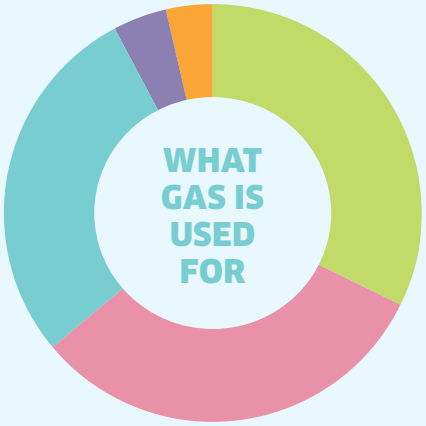
This document outlines a vision of how locally produced natural gas can help New Zealand in 2050 achieve the Government’s goals, and all three strands of what is known as the ‘Energy Trilemma’: ***sustainability***, ***affordability*** and ***reliability***.

These are the essential, interlinked elements of any energy system. Just achieving one or two is not enough – all three are essential.



See pages 18 – 19 for references

NATURAL GAS IN NEW ZEALAND TODAY

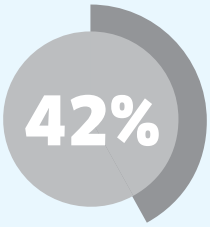


NEW ZEALAND NATURAL GAS CAN HELP THE WORLD **LOWER** ITS EMISSIONS

NATURAL GAS AND LPG **POWERS OVER 400,000** HOMES, BUSINESSES AND COMMUNITY FACILITIES

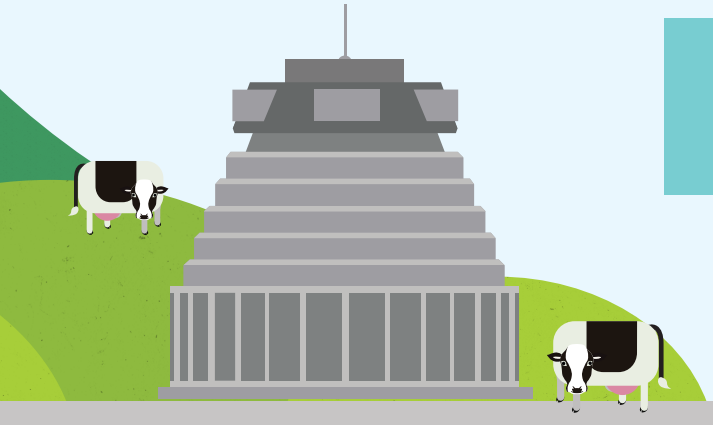
100% OF NEW ZEALAND'S **NATURAL GAS** IS CURRENTLY PRODUCED **IN TARANAKI**

NATURAL GAS HAS **HALF THE EMISSIONS OF COAL**



OF ALL PROFIT FROM ANY NEW PRODUCING FIELD IS PAID TO THE NEW ZEALAND GOVERNMENT

CONTRIBUTES JUST 9% OF NZ'S EMISSIONS[6]



*(e.g. methanol & fertiliser)

See pages 18 – 19 for references

SUSTAINABLE

The world is moving towards a lower-emissions future and natural gas is a crucial part of these efforts.

This section outlines some of the ways natural gas is helping to lower emissions – and how this can be accelerated.[7] However, it is important to remember none of these options on their own are a silver bullet. All parts of society need to contribute to efforts to lower net emissions.

Natural gas to replace coal

Natural gas has half the emissions of coal, which currently provides 28% of the world's energy and 45% of global carbon dioxide emissions.[8] Coal is the single biggest global emitter of greenhouse gas (GHG) emissions, and it's use (especially for electricity generation) continues to grow in Asia.[9]

Here in New Zealand coal is still widely used for industrial processes such as milk plants and timber processing, for heating hospitals and schools and occasionally producing electricity. Switching these processes to natural gas could therefore lead to a major reduction in New Zealand's emissions.

Discovering and developing new natural gas resources in New Zealand could speed up the transition away from coal. It could also be exported overseas as LNG (or in another form like hydrogen or methanol) to countries in Asia, making a significant contribution to reducing global emissions by displacing higher emitting energy sources.

This is already happening globally as countries like Australia and the US are becoming major exporters of LNG. According to the International Energy Agency:

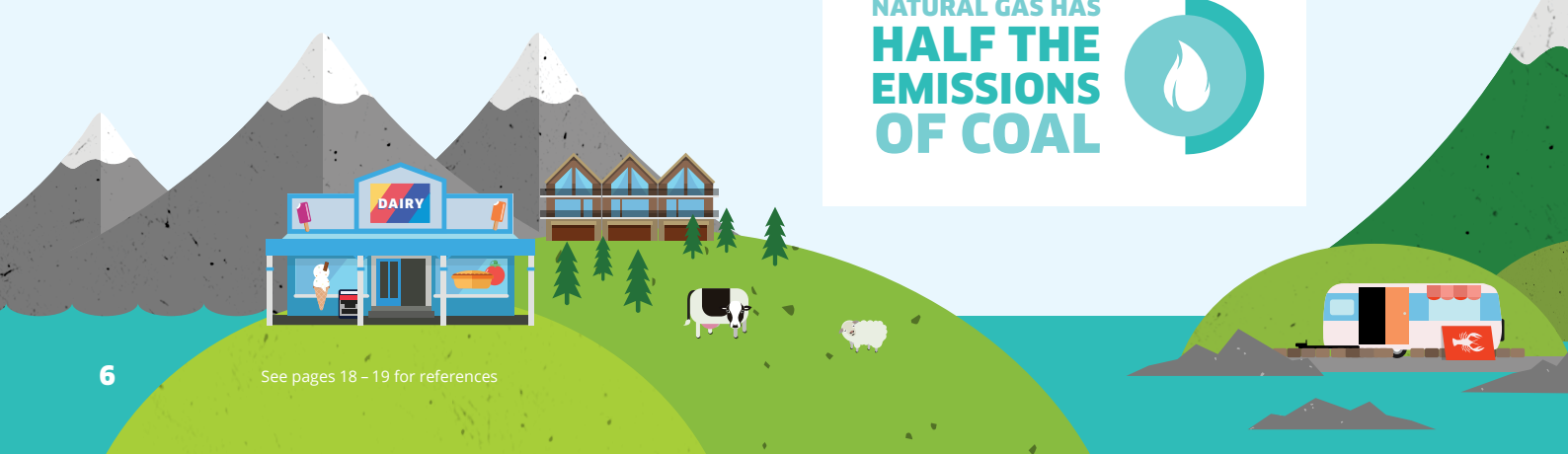
> **"...fuel switching between coal and gas accelerated in 2018, reducing the carbon intensity of global energy use. Driven by economics and policies, coal-to-gas switching avoided almost 60 [million tonnes] of coal demand, with the transition to less carbon-intensive natural gas helping avert 95 [million tonnes] of CO_2 emissions."**

This switch is the major reason why the United States' carbon dioxide emissions fell 14% between 2005 and 2017, and why the UK's emissions have fallen to their lowest level since the 19th century (36% below 1990 levels).[10]

Around the world, natural gas has been a direct substitution for coal at a rate of nearly 1:1. This has delivered enormous improvements to air quality, saving lives and massively reducing emissions.[11]

As a consequence natural gas is booming around the world with demand expected to grow 45% by 2040.[12] It is widely seen as a cleaner, affordable and reliable fuel source of the future.[13]

NATURAL GAS HAS HALF THE EMISSIONS OF COAL



See pages 18 – 19 for references

Using natural gas to produce hydrogen

Natural gas provides the most affordable and realistic method for creating hydrogen, which has been earmarked by the Government as a zero-emissions fuel with great potential.[14]

Hydrogen is already produced in large quantities in New Zealand using natural gas and used to create petrochemicals such as urea fertiliser and methanol. The challenge is making hydrogen practical, affordable and usable for energy uses.

Around the world natural gas is by far the most common feedstock for creating hydrogen and with the use of carbon capture and storage (CCS) technology could be produced with zero emissions (known as 'blue hydrogen').[15]

A recent report by Concept Consulting estimated the cost of 'blue' hydrogen at $2.70 per kg, which is three times lower than using electricity (known as 'green' hydrogen).[16]

BLUE HYDROGEN
$2.70 PER KG

GREEN HYDROGEN
$8.91 PER KG

Hydrogen produced from natural gas could enable customers to invest in hydrogen infrastructure while electrolysis technology is developed and becomes more cost effective over time.

Encouraging electrification

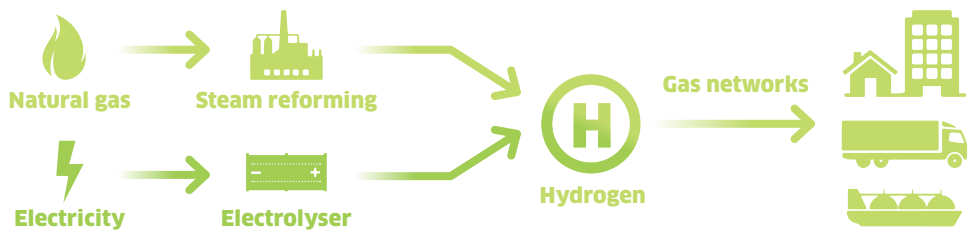
Switching industrial heat and transport towards using electricity can also help lower emissions, given that 82% of New Zealand's electricity is generated from renewable sources which generally have lower emissions.[17]

Natural gas can help this transition by keeping the price of electricity down. It plays a critical role in backing up renewable sources that can be disrupted by the weather (i.e. wind, solar and hydro), and for managing daily and seasonal peaks which would otherwise push the price to consumers much higher.

A recent report by the New Zealand Initiative considered the difficulties of completely replacing this role for natural gas and coal in our electricity system: *"Tackling it could add more than $800 million to the annual cost of electricity. The higher cost of electricity under such a scenario would delay the transition from fossil fuels to electricity. Perversely, this could increase overall carbon emissions."*[18]

As summarised by Simon Coates of Concept Consulting, "*Lower cost electricity facilitates the far bigger prize of decarbonising process heat and decarbonising transport.*"[19]

This view is shared by the Interim Climate Change Committee which has implicitly recognised the role of natural gas by noting the difficulties of the Government's target of 100% renewable electricity by 2035: *"Emissions reductions will only succeed when based on a foundation of affordable, abundant and secure electricity for all."*[20]



See pages 18 – 19 for references

A robust and consistent Emissions Trading Scheme (ETS)

Putting a price on emissions is the most effective policy tool for encouraging the reduction of emissions because it allows the market to find the most efficient ways to do this.

New Zealand's ETS creates a direct financial incentive for businesses to invest in technologies and practices that reduce emissions. It also encourages forest planting which helps absorb emissions.

Various studies (including the 2018 Nobel Prize joint winner for economics) have shown that emissions pricing is the most cost-effective way of reducing emissions.[21] Other 'top-down' measures like subsidising alternative energy sources or banning activities tend to be far less effective, costing large amounts of money and in many cases even increase emissions as a result.

This is largely because of the complexity involved: policy makers will rarely know better than the market the most efficient ways of reducing emissions at least cost. As the New Zealand Initiative points out in a recent report:

> **"Emissions occur in many places in an economy, with each source having its own abatement cost that depends on the value of the activity and the relative cost of non-emitting alternatives to that activity... And to make matters considerably more complicated, abatement costs vary not only by source but by each person... These costs may be obvious to the individuals affected, but they are almost entirely invisible to policymakers as they design their interventions."[22]**

For this reason, the ETS is the Government's principal policy response to reducing and offsetting emissions.

PEPANZ believes it should be consistently applied and include all sectors, including agriculture. At present the agricultural sector is responsible for just over half of New Zealand's greenhouse gas emissions but is not financially liable under the ETS.

It is also important that the ETS evolves in line with similar schemes in other countries to avoid the problem of 'carbon leakage', whereby production shifts to different jurisdictions with the same (or higher) level of emissions.

If there is adequate global action, emissions pricing means that over time the most efficient hydrocarbon sources will be developed. Higher emitting sources like coal will become less economic, while cleaner sources such as natural gas will become more preferential.

"THE ETS SHOULD CONTINUE TO BE THE GOVERNMENT'S MAIN POLICY TOOL FOR REDUCING EMISSIONS, AND APPLIED EQUALLY TO ALL EMITTERS INCLUDING AGRICULTURE."

See pages 18 – 19 for references

International trading of carbon credits

International trading of carbon credits means that New Zealand businesses could purchase foreign 'credits' to make up for domestic emissions they might create.

For example, if Australia could reduce emissions for a lower cost than New Zealand, it would make sense for New Zealand to purchase emissions reductions made by them rather than trying to reduce our own domestic emissions by the equivalent amount at a higher cost.

Economic modelling commissioned for the Ministry for the Environment on the Zero Carbon Bill shows access to these credits would dramatically reduce the cost of lowering emissions for New Zealand. The report by NZIER finds the difference could be as much as $15 billion by 2050.[23]

Article 6 of the Paris Agreement provides for bilateral and regional cooperation in the trading of international carbon mitigation credits. While a process for this has not yet been agreed on, it should be a priority for Governments around the world.

Carbon capture and storage

Carbon capture and storage (CCS) is the process of capturing carbon emissions from large sources such as power plants and large industrial users and storing them where they cannot escape into the atmosphere. Often this is deep underground in geological formations where natural gas originally came from.

Large scale CCS is a reality today and can remove as much as 90% of carbon dioxide from major projects. There are currently 21 active, large scale projects around the world with capacity to capture 37 million tonnes of CO_2 per year.[24]

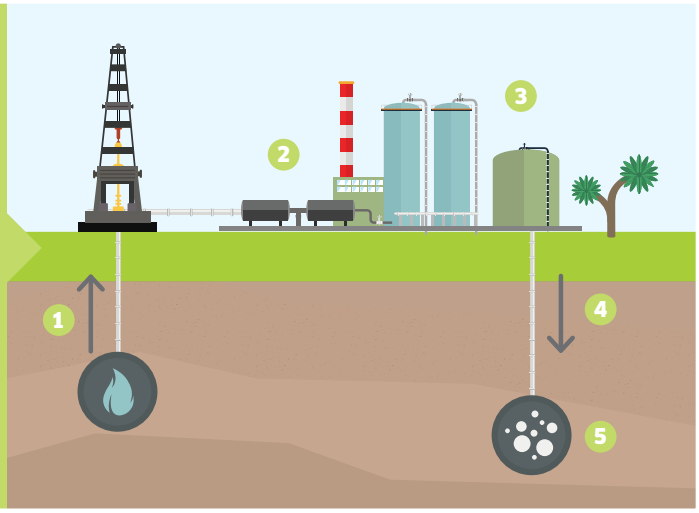
Here in New Zealand, the 8 Rivers company has proposed building an industrial facility in Taranaki to produce electricity, urea and hydrogen fuel with zero-emissions using CCS.[25]

In Western Australia the Gorgon natural gas development is aiming to capture and store between 3.4 and 4 million tonnes of reservoir CO_2 each year.[26]

However, the lack of an enabling regulatory framework for the use of this technology in New Zealand may not provide enough certainty for investors. PEPANZ recommends changes are made to relevant legislation to allow this technology to be deployed.

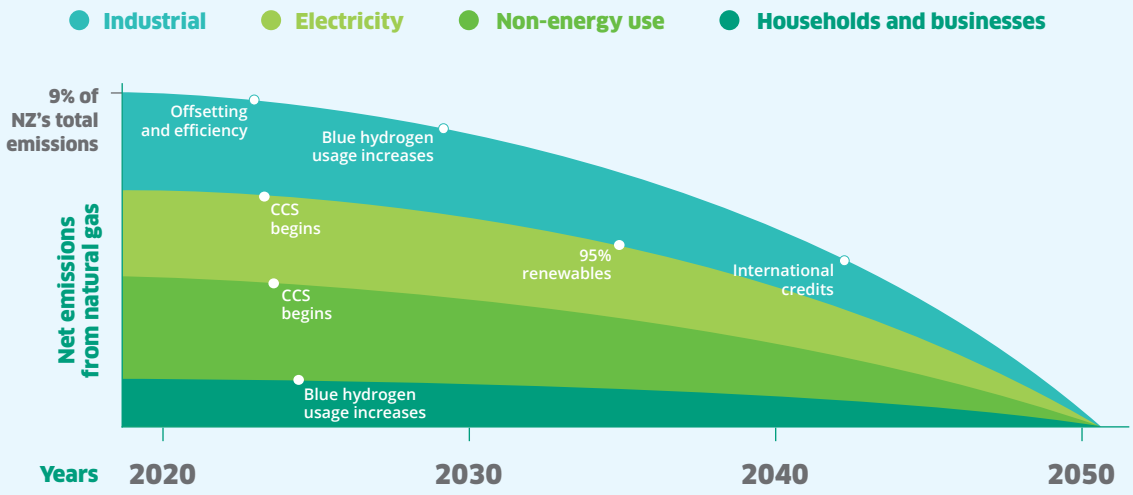
CCS: Storing CO_2 underground

1. **Natural gas is extracted from reservoirs and used**
2. **Natural gas used to create electricity and/or power industry**
3. **CCS technology captures CO_2 emissions before they enter the atmosphere**
4. **CO_2 is pumped deep underground**
5. **CO_2 is safely and permanently stored**



See pages 18 – 19 for references

How natural gas usage could reach net zero emissions



Using royalties to develop lower emissions technology

PEPANZ has long advocated for the public royalties from petroleum production to be invested into a dedicated fund for the long-term benefit of New Zealanders, rather than paid into the Government's Consolidated Fund as is the case now.

This could be used to invest in new energy technology and help Taranaki and New Zealand transition to, and thrive in, a lower emissions world.

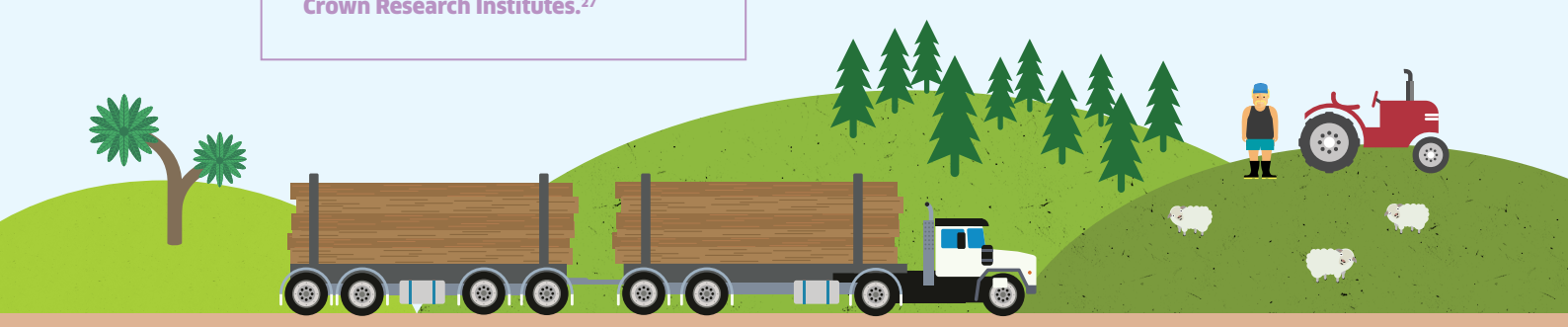
Over the last 10 years the Government has collected an average of $339 million per year in royalties and levies on the petroleum industry. This would be enough to fund two or three new Crown Research Institutes.[27]

Non-energy use

It's worth remembering many uses of natural gas do not involve burning it. In fact, around 28% of natural gas use in New Zealand is for non-energy use.[28]

Natural gas is used as feedstock to make fertiliser and a range of chemical products including ammonia, hydrogen and methanol. It's worth noting, however, that emissions can still result if the methanol is burnt as a fuel and from the fertiliser breaking down over time.

Other uses of natural gas include producing plastics and medical gas. In many cases there is no substitute for natural gas, and if New Zealand did not manufacture these products they would need to be imported, creating a likely increase in global emissions.[29]



See pages 18 – 19 for references

AFFORDABLE

How natural gas affects the cost of energy

Natural gas provides around 15% of New Zealand's electricity supply and is an important back-up when renewable sources are not available; for example, when hydro lakes are low, the wind isn't blowing and the sun isn't shining.[30]

Thanks in part to natural gas, New Zealand consumers pay the 12th lowest electricity prices among 33 OECD countries and for industry it is the 7th lowest.[31]

However, removing the role of natural gas and coal from the electricity system could add more than $800 million to the annual cost for users.[32]

This would have a major impact on industrial users who rely on natural gas for heat processes, such as:

- Milk plants
- Timber processing
- Food processing (such as baking and brewing beer)
- Glass, bricks, paper and plastic manufacturing.

Affordability is also important to around 400,000 direct users of natural gas and LPG for heating and cooking. This includes households, schools, hospitals, shops, restaurants and a wide range of businesses.

Trying to completely replace the role of natural gas in electricity generation, heavy vehicles and industrial heat would be an enormous challenge. According to research by Vivid Economics, the total cost could be $7.2 billion per year by 2050. This works out to $2,700 per household per year, or nearly $52 per week extra in increased costs.[33]

Minimising the cost to New Zealanders of the energy transition

The cost of transitioning to a lower emissions economy will be high, especially for petrol and electricity prices. The wider costs of this will flow through to consumer goods and these significant costs will be felt by households, and particularly lower-income New Zealanders.

The Ministry for the Environment has commissioned a range of forecasts showing New Zealand's GDP could be 10 – 21% lower in 2050 than would otherwise be the case in order to meet the net zero emissions target. According to modelling done for the Ministry, this would mean household income per year is $12,000 lower.[34]

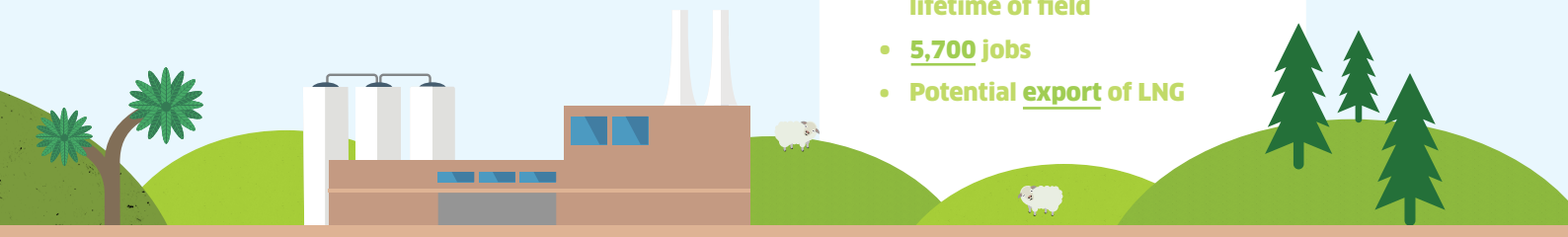
The discovery and development of one large natural gas field alone could be worth tens of billions to New Zealand. Some of the proceeds could be used for emission reduction initiatives and lowering the cost of energy for New Zealanders.

NEW ZEALAND'S OIL AND GAS INDUSTRY TODAY

- Contributes $2.5 billion to GDP annually
- $500 million per year in royalties and taxes
- 11,000 jobs

THE BARQUE GAS FIELD PROSPECT[35]

- Potential $32 billion in Government royalties over lifetime of field
- 5,700 jobs
- Potential export of LNG



See pages 18 – 19 for references

RELIABLE

The instant availability and reliability of natural gas for electricity generation is one of its greatest qualities. It can be easily stored and quickly turned on in a matter of minutes when required to generate electricity.

As outlined earlier, natural gas provides a readily-available back-up for renewables when the weather isn't co-operating. This is especially true at peak demand times such as cold, still winter evenings.

In this way, natural gas supports renewable energy by making it more reliable and affordable.

Finding an alternative way of storing energy to use at these peak times would be an expensive and difficult challenge. According to Genesis Energy, without the 'dry year support' provided by natural gas and coal, New Zealand would need six to eight hydro storage reservoirs each the size of Lake Taupo.[36]

> **"NATURAL GAS SUPPORTS RENEWABLE ELECTRICITY GENERATION BY MAKING IT MORE RELIABLE AND AFFORDABLE."**

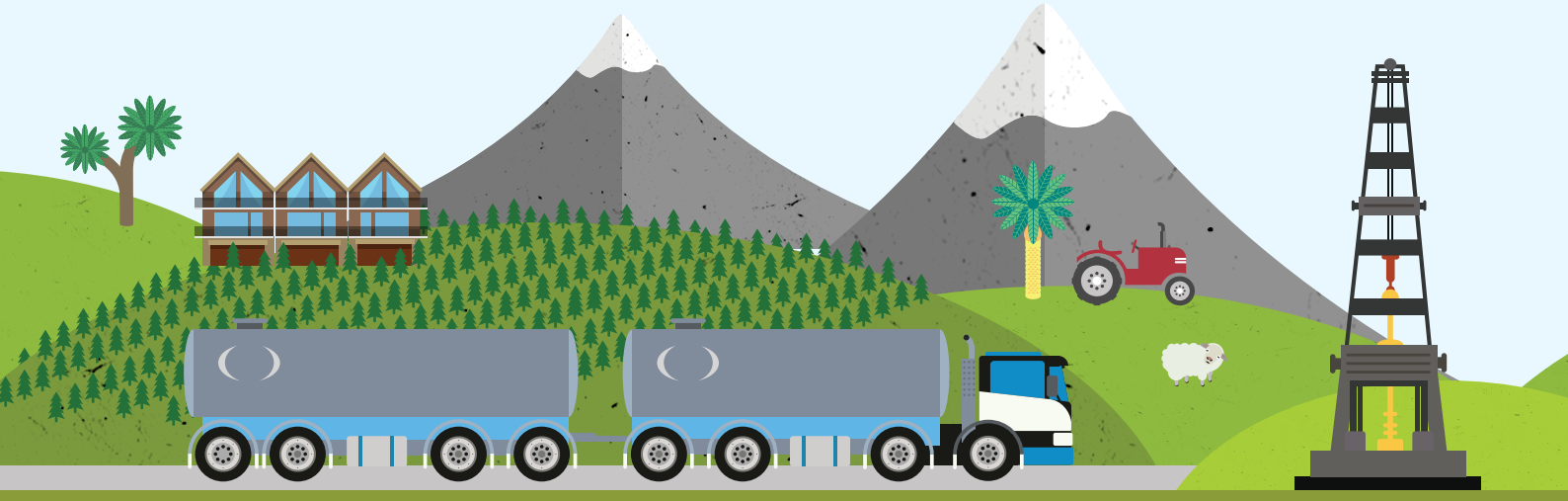
Battery storage is another option but is only useful for short periods of time, rather than many months of winter. According to research by Infratil they are "*...currently irrelevant. They store little and cost lots*." It is estimated that a battery with the same storage capacity as a typical hydro lake would cost $480 billion.[37]

Alternatively, it could be possible to build substantially more renewable electricity generation than normally required so that it could deliver when needed, but this would be hugely expensive and a highly inefficient use of resources.

Without natural gas, New Zealand is more likely to rely on imported coal or LNG to support the electricity system which results in much higher emissions. This is exactly what occurred over the summer of 2018/19 as coal usage for electricity generation reached a five-year high following a temporary natural gas supply constraint.[38]

As well as producing higher emissions, this is also likely to mean more expensive electricity for consumers.[39]

New Zealand's electricity supply needs to double by 2050, according to Transpower.[40] This makes the role of natural gas even more important.[41]



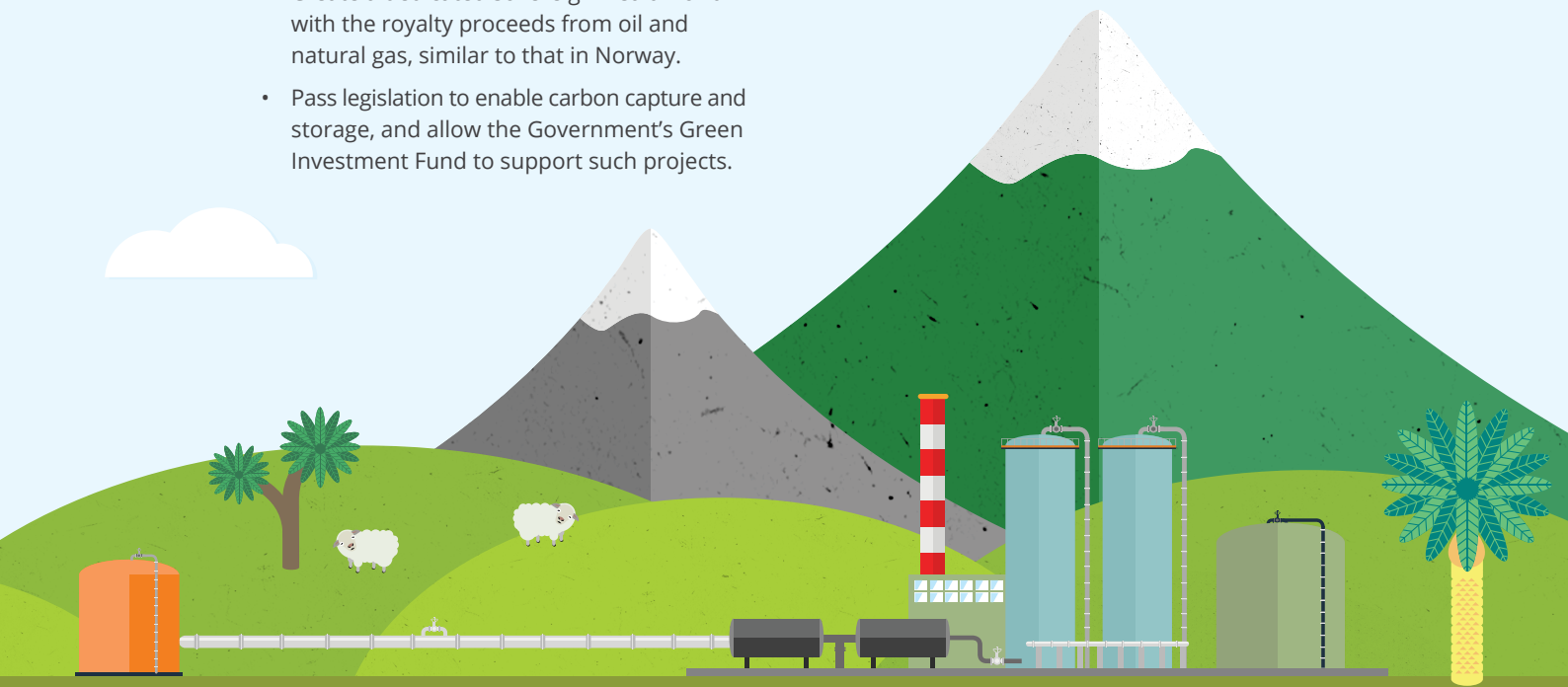
See pages 18 – 19 for references

A NEW WAY FORWARD FOR NATURAL GAS

Natural gas produced in New Zealand clearly has a key role in making our energy system sustainable, affordable and reliable.

While a full detailed prescription is available in our publication "*Advancing New Zealand's Petroleum Sector*"[42], here are some key ideas on how we could achieve this vision:

- Continue to recognise the importance and value of domestically produced natural gas in underpinning the electricity system and industrial, commercial and domestic consumers.
- Consider the global rather than just national impacts of exploration and development. For example, does limiting new exploration in New Zealand mean more development overseas of oil and natural gas with a higher carbon footprint instead? Will there be 'carbon leakage' if large users of natural gas shift overseas and use coal instead of natural gas?
- To this end, allow new exploration and development of locally-produced oil and natural gas reserves (beyond just onshore Taranaki as is currently the case).
- Create a dedicated sovereign wealth fund with the royalty proceeds from oil and natural gas, similar to that in Norway.
- Pass legislation to enable carbon capture and storage, and allow the Government's Green Investment Fund to support such projects.
- Have a robust ETS covering all sectors, including agriculture and all greenhouse gases.
- Facilitate international trading of high-quality carbon credits.
- Aim to have support for these policies from all political parties to give long-term certainty to the industry and major consumers of natural gas. This is important because exploration and development takes decades, as does investment into electricity generation and industrial heat facilities.
- Policy settings should encourage lower emissions but be neutral towards different fuels and technologies. It is very risky for Governments to try and 'pick winners' as it is impossible to know which will be successful and at what cost. Instead, all technologies and fuels should have the chance to prove themselves and meet the energy trilemma (sustainable, affordable and reliable).



See pages 18 – 19 for references

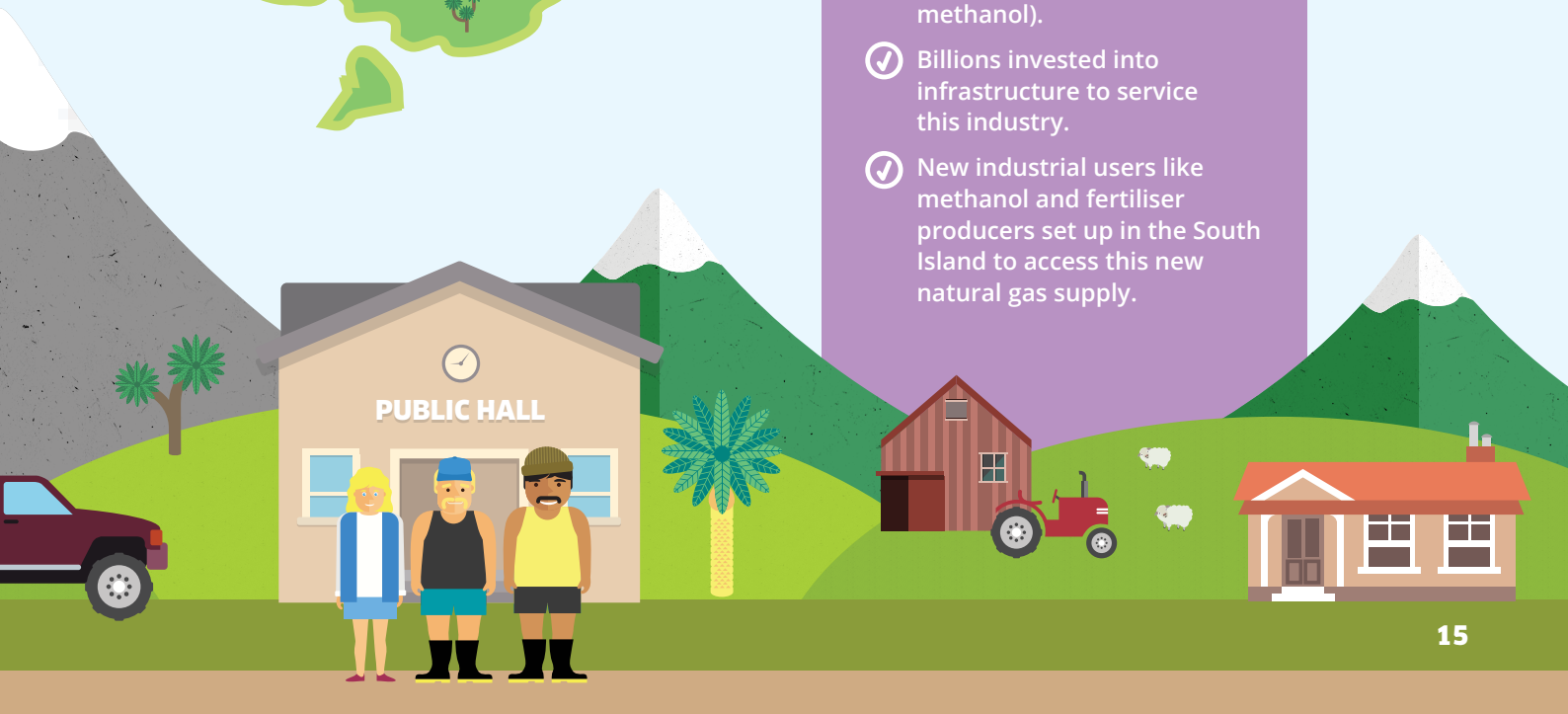
WHAT 2050 COULD LOOK LIKE – THANKS TO NATURAL GAS

- Electricity supply has doubled with natural gas providing a similar amount as today, but a smaller total percentage (around 2 – 3%) as a back-up to and enabler of renewable sources.
- CCS technology potentially used to capture emissions.
- Less oil produced as electric cars are more widespread.
- Hydrogen and LNG powering heavy vehicles.
- Natural gas and hydrogen providing power for process heat in industries like milk and timber processing.
- New Zealand becomes self-sufficient in urea fertiliser, with cost savings for farmers and decreased transport emissions as imports are no longer required.
- New sports stadiums, WOMAD-type festivals and major community and environmental projects in the South Island thanks to sponsorship from locally operating energy companies.

- A New Zealand sovereign wealth fund could be created to invest the proceeds of new developments (noting that Norway's current fund is worth over $1 trillion).
- Royalties from natural gas fields could also be invested into world-leading scientific research to reduce emissions.
- Higher incomes for New Zealanders from new jobs and businesses related to new natural gas fields.
- Higher quality Government services (such as health and education) funded through taxes and royalties from the petroleum sector.
- Over a billion new trees planted to capture emissions.
- New Zealand achieves net zero (or net-negative) emissions.

- Hydrogen produced from natural gas in Taranaki with CCS and zero emissions; also producing fertiliser and electricity.
- Natural gas production plants operating in Taranaki with significantly less emissions.
- Methanol produced in Taranaki with zero emissions thanks to CCS technology, providing a lower carbon fuel for global use (especially for shipping).

- Natural gas and/or hydrogen piped throughout the South Island. Big users like dairy plants have long since finished using coal.
- Natural gas exported to Asia from South Island fields as part of a booming global market for LNG (and potentially hydrogen and methanol).
- Billions invested into infrastructure to service this industry.
- New industrial users like methanol and fertiliser producers set up in the South Island to access this new natural gas supply.



POLICY SETTINGS

Policy	Sustainable	Affordable	Reliable
Allow new exploration and development of natural gas and oil throughout New Zealand	✓	✓	✓
Create a dedicated sovereign wealth fund to invest royalty proceeds			
Legislation to enable CCS	✓	✓	✓
A robust ETS covering all sectors	✓		
International trading of carbon credits	✓	✓	

NATURAL GAS IN OUR LIVES BY 2050

In the home: A combination of natural gas and hydrogen provide heating, hot water and cooking.

In cities: Along with hydrogen, natural gas provides energy for small business such as restaurants along with schools and hospitals.

Industry: Natural gas will continue to be crucial as electricity isn't practical for many heat processes used in producing food and building materials. Hydrogen produced from natural gas could be an option and CCS could be used at major plants, along with offsetting (planting trees) and the use of high-quality international carbon credits.

Electricity generation: Renewable sources will grow. Natural gas will provide a smaller (likely 2 – 3%) share but this will be a crucial backup keeping prices affordable for when the weather isn't cooperating e.g. when hydro lakes are low.

Transport: Hydrogen and possibly LNG could be used for heavy transport. The number of electric vehicles is likely to greatly increase and be reliant on gas peaking power to complement renewable electricity.

Exports: Global demand for natural gas is booming and especially in Asia. New Zealand could be an exporter of LNG, helping replace coal and contributing to a major reduction in global emissions.

RENEWABLE ELECTRICITY – MADE POSSIBLE BY NATURAL GAS

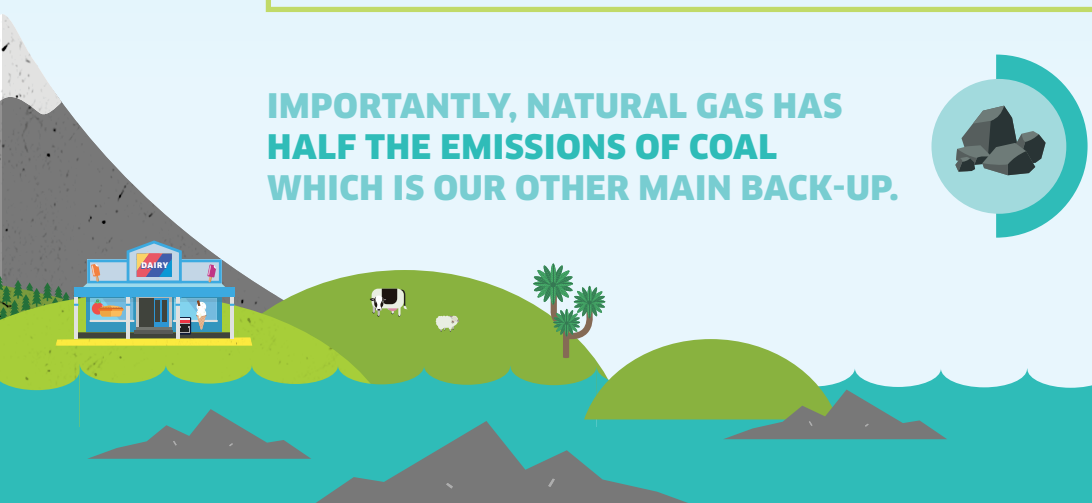
RENEWABLE ENERGY PROVIDES 85% OF OUR ELECTRICITY

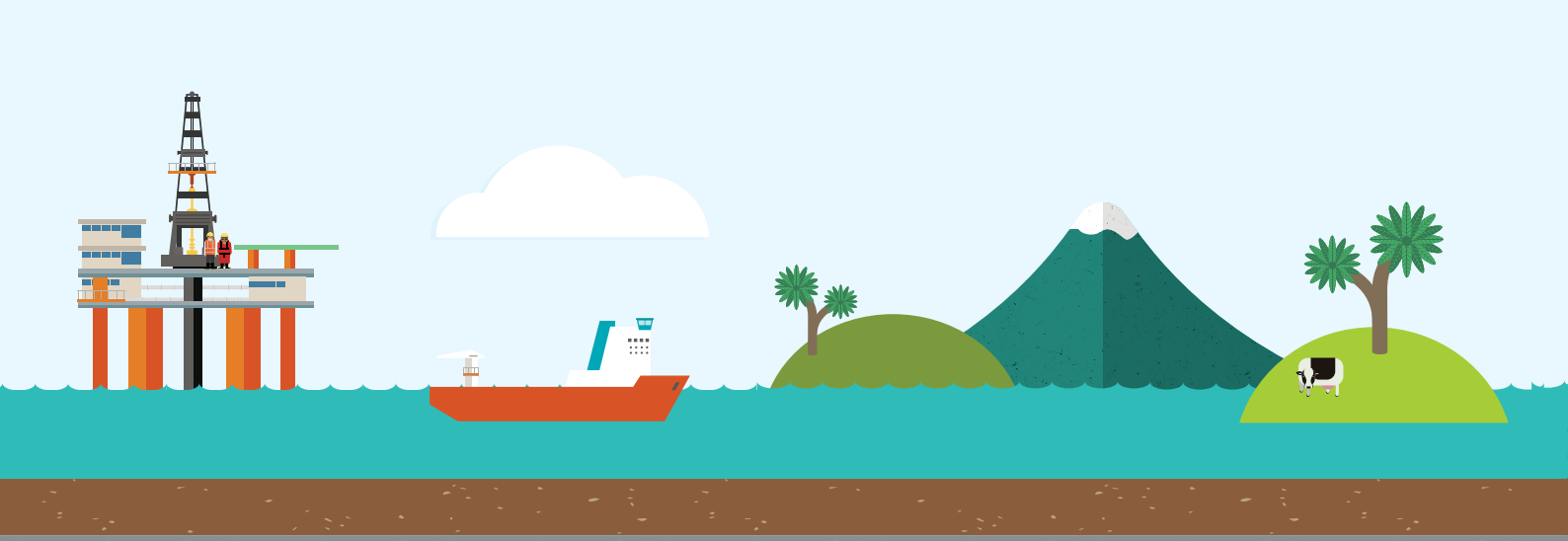
BUT IT CAN BE UNRELIABLE BECAUSE OF THE WEATHER, ESPECIALLY IN WINTER

15% IS PROVIDED BY NATURAL GAS

Natural gas is easily available at the flick of a switch. By providing this crucial back-up, it supports and enables renewable energy to provide most of our electricity.

IMPORTANTLY, NATURAL GAS HAS HALF THE EMISSIONS OF COAL WHICH IS OUR OTHER MAIN BACK-UP.





REFERENCES

1. *Gas Infrastructure Futures in a Net Zero New Zealand*, prepared for PowerCo and First Gas by Vivid Economics (2018) page 45. https://www.powerco.co.nz/media/2008/16098-first-gas_future-of-gas-report-dec18-final-high-res.pdf

2. In 2017 natural gas provided 21% of New Zealand's primary energy supply. *Energy in New Zealand*, Ministry for Business, Innovation and Employment (2018)

3. Which gases this will apply to (such as methane from agricultural emissions) is still under consideration

4. *Energy in New Zealand*, Ministry of Business, Innovation and Employment (2018)

5. From New Zealand Petroleum and Minerals: "Gas reserves, defined as quantities that are commercially recoverable, stood at 1,985 Petajoules at 1 January 2018. It represents around 10.5 years of demand at 2017 demand levels." https://www.nzpam.govt.nz/about/news/release-of-petroleum-reserves-data/

6. *Gas Infrastructure Futures in a Net Zero New Zealand*, prepared for PowerCo and First Gas by Vivid Economics (2018). https://www.powerco.co.nz/media/2008/16098-first-gas_future-of-gas-report-dec18-final-high-res.pdf

7. For more detail see our 2018 publication "The Future of Oil and Gas in a Lower Carbon World"

8. International Energy Agency '*CO_2 emissions from fuel combustion*' 2017

9. IEA Global Energy and CO_2 report, April 2019: https://www.iea.org/geco/emissions/ and https://www.iea.org/geco/coal/

10. UK carbon emissions drop to lowest level since 19th century, study finds" *The Guardian* 7 March 2017 and "*Analysis: Why US carbon emissions have fallen 14% since 2005*" Zeke Hausfather, Carbon Brief 15 August 2017

11. See for example https://ourworldindata.org/death-uk-coal

12. *World Energy Outlook* International Energy Agency (2018) page 171

13. See the International Gas Union's website for numerous examples: https://www.igu.org/

14. Prime Minister Jacinda Ardern and Energy and Resources Minister Megan Woods launched the 'H2 Taranaki Roadmap' on 15 March 2019, funded by New Plymouth District Council, Hiringa Energy, Venture Taranaki, and the government's Provincial Growth Fund

15. See for example the "*H2 Taranaki Roadmap: How hydrogen will play a key role in our energy future*", Venture Taranaki (2019) http://about.taranaki.info/Tapuae-Roa/H2.aspx

16. *Hydrogen in New Zealand – Report 1 Summary*, Concept Consulting (January 2019). This assumes very large-scale production with carbon capture and storage (CCS), and carbon costs of $100 per tonne CO_2 for this estimate: http://www.concept.co.nz/uploads/2/5/5/4/25542442/h2_report1_summary_v4.pdf

17. Note that geothermal energy is renewable but does still generate some GHG emissions. A range of recent reports have considered the benefits and challenges of electrification, including the Productivity Commission's *Low emissions economy* (2018) https://productivity.govt.nz/inquiry-content/3254?stage=4

18. New Zealand Initiative media release "New report: Pricing carbon properly key to successful renewables policy", 27 March 2019. https://nzinitiative.org.nz/reports-and-media/media/media-release-new-report-pricing-carbon-properly-key-to-successful-renewables-policy/

19. "Govt open to changing goalposts on 100% renewable target – Shaw", *New Zealand Herald* 6 March 2019

20. Interim Climate Change Committee presentation "Hui thought starters": https://www.iccc.mfe.govt.nz/our-news/updates-from-the-chair/iccc-engagement-maori-thought-leaders/

21. See for example: "Economics Nobel prize given for putting a price tag on climate change", *New Scientist* 8 October 2018

22. A highly detailed study of this issue is covered in the report "*Switched on! Achieving a green, affordable and reliable energy future*" New Zealand Initiative (2019) https://nzinitiative.org.nz/reports-and-media/reports/switched-on-achieving-a-green-affordable-and-reliable-energy-future/

23. *Economic impact analysis of 2050 emissions targets: A dynamic computable general equilibrium analysis*, NZIER (2019) page xvi

24. *Energy Transition Outlook 2018*, Oil and Gas UK

25. PR Newswire "NET Power Achieves Major Milestone for Carbon Capture with Demonstration Plant First Fire" 30 May 2018

26. https://australia.chevron.com/-/media/australia/publications/documents/gorgon-co2-injection-project.pdf

27. Annual Crown revenue from the oil and gas industry is available at http://www.energymix.co.nz/our-benefits/essential-services/. There are seven Crown Research Institutes with an average annual revenue of $105 million per year (source: 2018 annual reports)

28. *Energy in New Zealand*, Ministry of Business, Innovation and Employment (2018)

29. See for example the report "*Emissions Intensive Trade Exposed Businesses' Contribution to New Zealand's Low Emissions Economy*" by Castalia Strategic Advisors, commissioned by Business New Zealand. The report shows the risks of industries like methanol production moving overseas, increasing global emissions and damaging New Zealand's economy

30. ibid

31. Miriam R. Dean, et al. "Electricity Price Review Hikohiko Te Uira, First report for discussion" (Wellington: New Zealand Government, 2018), 23 – 24

32. New Zealand Initiative media release "New report: Pricing carbon properly key to successful renewables policy", 27 March 2019. https://nzinitiative.org.nz/reports-and-media/media/media-release-new-report-pricing-carbon-properly-key-to-successful-renewables-policy/

33. *Gas Infrastructure Futures in a Net Zero New Zealand*, prepared for PowerCo and First Gas by Vivid Economics (2018) page 45. https://www.powerco.co.nz/media/2008/16098-first-gas_future-of-gas-report-dec18-final-high-res.pdf

34. *Zero Carbon Bill economic analysis: A synthesis of economic impacts* (2018) Ministry for the Environment (page 19). https://www.mfe.govt.nz/sites/default/files/media/Climate%20Change/Zero-Carbon-Bill-Economic-Analysis-Report-FINAL.pdf

35. See for example this report into the Barque prospect near Oamaru which estimates $32 billion in Crown revenue over the lifetime of the field: *Barque Field Development Economic Impact Assessment* (2017) MartinJenkins https://www.nzog.com/dmsdocument/333

36. Genesis Energy submission on the Crown Minerals (Petroleum) Amendment Act 2019 (page 3) https://gesakentico.blob.core.windows.net/sitecontent/genesis/media/new-library-(dec-2017)/about_us/investor/submissions/genesis-submission-crown-minerals-(petroleum)-amendment-bill.pdf

37. Infratil Update September 2018 https://infratil.com/assets/Uploads/20180928-Infratil-Update-Newsletter-Sept-2018.pdf

38. "Genesis coal burn reached five-year high in 'unprecedented' conditions" *New Zealand Herald* 22 January 2019. https://www.nzherald.co.nz/business/news/article.cfm?c_id=3&objectid=12194335

39. ibid

40. *Te Mauri Hiko – Energy Futures,* Trustpower (2018)

41. It is worth noting here that late in 2018 a temporary interruption of supply from the Pohokura gas field caused electricity prices to rise. This was seized upon by some critics as proof that natural gas is unreliable, but this was overstating the case. Such interruptions are rare, usually confined to one field and have less of an impact than a prolonged dry spell has on hydro electricity. The Pohokura issue highlighted the ramifications of natural gas supplies running dry

42. https://www.pepanz.com/dmsdocument/15

GLOSSARY

GHG: Greenhouse Gases which contribute to a changing climate. In New Zealand these are mainly carbon dioxide (primarily from the combustion of oil and gas in transport and industrial heat processes) and methane (mostly from agricultural animals).

CCS: Carbon Capture and Storage.

ETS: Emissions Trading Scheme which puts a price on GHG emissions; the New Zealand Government's main tool for reducing greenhouse gas emissions.

LPG: Liquified Petroleum Gas. Supplied in gas bottles around New Zealand for use on BBQs and households in areas where natural gas isn't available via pipeline.

LNG: Liquified Natural Gas. The most commonly exported form of natural gas for which there is a strongly growing global demand. LNG takes up significantly less space as a liquid than a gas (approximately 1/600th the volume), making it ideal for international transport. In its physical state natural gas can only be transported via pipelines, but once turned in to a liquid in can be transported by specialised ships. LNG is converted back into a gas once it reaches its destination.

CO_2: Carbon Dioxide.

PEPANZ – WHO WE ARE

PEPANZ is the industry association of the upstream oil and gas sector.

Established in 1972, PEPANZ works with local and central government to ensure New Zealand's regulatory and commercial framework promotes quality investment, and that the return from the country's oil and natural gas resources is maximised for industry, government and the community.

PEPANZ works to increase community and government understanding of the industry by publishing information about the sector's activities and economic importance to the nation.

As representatives of New Zealand's oil and gas industry, PEPANZ also provides its members with strong representation and advocacy, leadership for industry wide issues, while engaging openly and honestly with New Zealanders.

OUR MEMBERS

We are proud to both represent and advocate on behalf of our 50 members, who through their activities are helping grow the New Zealand economy and secure New Zealand's long-term energy security.

Our membership is made up of a wide range of companies in the oil and gas sector – from some of the world's largest multinationals, right through to local companies who provide a range of essential services. Together, our membership is responsible for an estimated 95 percent of New Zealand's petroleum production and this scale allows us to advocate successfully on their behalf.

Large Producers

beach

OMV

TODD ENERGY

Large Explorers

Chevron

equinor

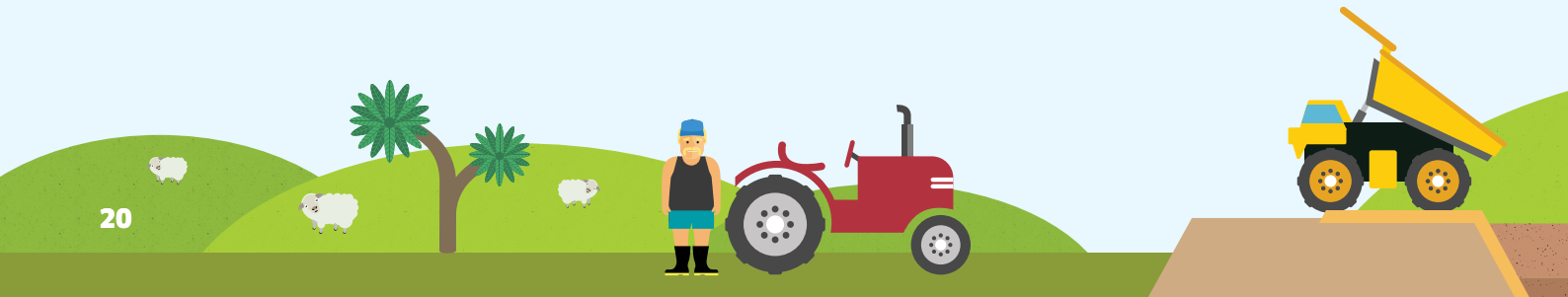
Medium Producers

WestSide

NEW ZEALAND OIL & GAS

TAG Oil

TAMARIND



Field Operations Servicer Providers

HALLIBURTON
KINETIC
OSD
Schlumberger
WEBSTER DRILLING
WorleyParsons resources & energy

Non-field Service Providers

BELL GULLY
btw company
CHAPMAN TRIPP
beca amec
Deloitte.
Elemental Group
BUDDLE FINDLAY
PortTaranaki
pwc
MARSH
LogiCamms
KPMG
SGS
Simpson Grierson
SLR global environmental solutions
MinterEllison RuddWatts LAWYERS
AECOM
Govett Quilliam THE LAWYERS
BRG
LANDPRO
ERM
GreenwoodRoche
Russell McVeagh
anderson lloyd.

Others

appec
hale & twomey
Longbay Petroleum Associates Ltd.
SEAN RUSH Energy & Infrastructure Law
totum
Dr. Peter Kamp

OUR STAFF

Meet our team of professionals

Cameron Madgwick

Chief Executive

Cameron is the Chief Executive of PEPANZ, a role he took up in September 2014. Cameron's interest in the oil and gas industry started at an early age. Growing up in Taranaki he saw first-hand how a strong and robust oil and gas industry can truly benefit a community – both their financial and social well-being.

With the knowledge he has gained as Chair of the Community Law Centres o Aotearoa, his background as a lawyer and the work he has done in various community engagement roles, Cameron is committed to ensuring New Zealanders have access to factual, honest and transparent information about the oil and gas industry, and strongly believes that growing the industry is vital to ensuring our energy security and strengthening our regional economies in a responsible and environmentally friendly manner.

Joshua O'Rourke

Policy Manager

Josh leads PEPANZ's policy programme, working with members and other stakeholders to promote policies that are fair and reasonable for the oil and gas sector.

Josh has a strong public policy background and understanding of the key regulatory matters relevant to the oil and gas sector. Previously Josh worked on petroleum policy at the Ministry for the Environment, the Environmental Protection Authority, and at the Ministry of Business, Innovation and Employment.

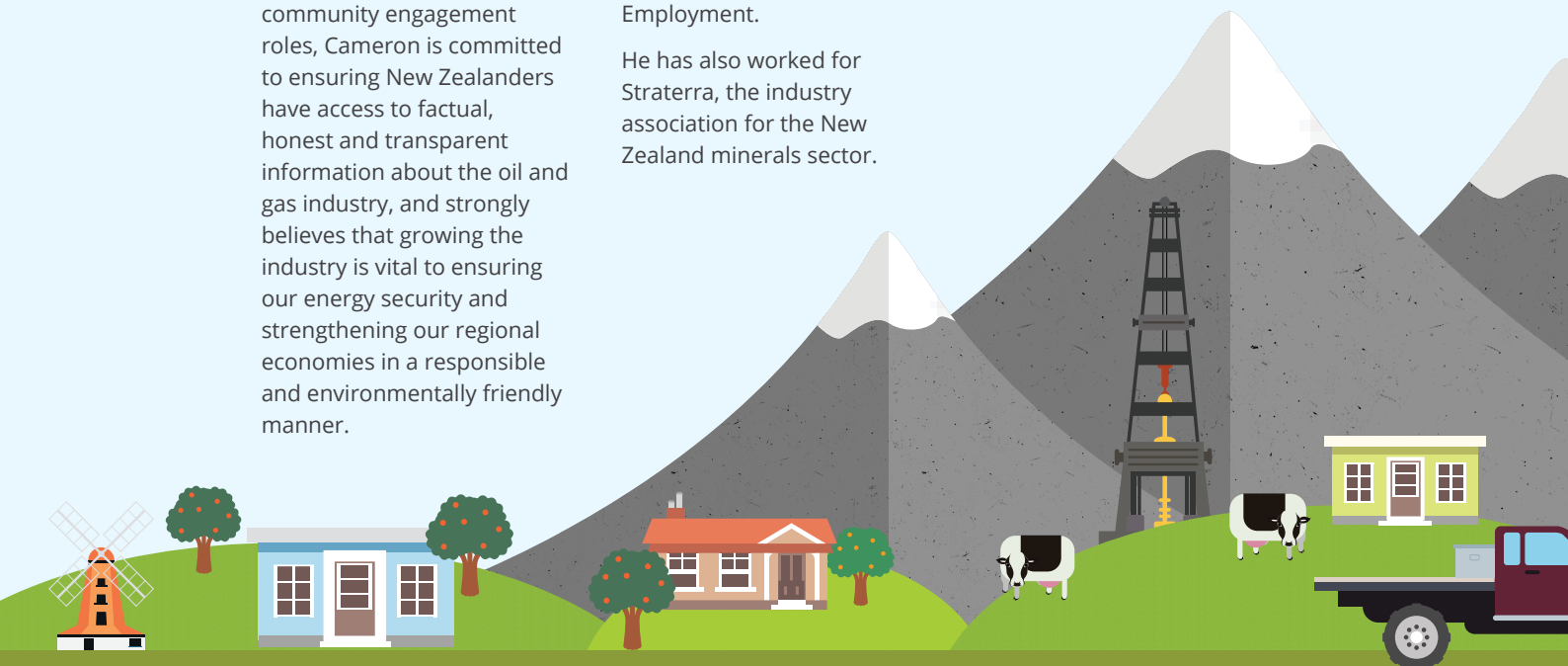
He has also worked for Straterra, the industry association for the New Zealand minerals sector.

Phil Rennie

Communications Manager

Phil leads PEPANZ's communications work, helping engage with and tell the story of the industry to stakeholders, the public and media. He is the first point of contact for any media enquiries.

Before joining PEPANZ, Phil worked as a Press Secretary to a Government Minister for eight years and has also worked in communications roles for professional membership bodies in New Zealand and overseas.



Carolyn Clark

Office and Events Manager

Carolyn is involved in the execution of all PEPANZ events, and takes the lead role in managing the annual New Zealand Petroleum Conference. She also ensures the smooth running of our Wellington office.

Carolyn brings with her a wide range of relevant experience. She has ensured the successful execution of many events, having worked in hospitality over a number of years, as well as having been a successful business manager.

She also brings with her nine years' industry experience, having worked at BP Oil NZ – based in Wellington, the central North Island and Auckland.

INTRODUCING...

NEW ZEALAND'S ENERGY MIX

PEPANZ is proud to present www.energymix.co.nz, a website providing accessible and easy to understand information on New Zealand's oil and gas sector right to the home computers and smartphones of New Zealanders.

The website provides honest and transparent information about the industry, including the challenge of ever increasing demands for energy, the future role of oil and gas given the need to respond to a changing climate, and the economic benefits our industry can deliver to the country.

www.energymix.co.nz

PEPANZ

PETROLEUM EXPLORATION & PRODUCTION
ASSOCIATION OF NEW ZEALAND